

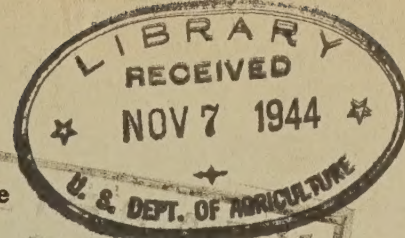
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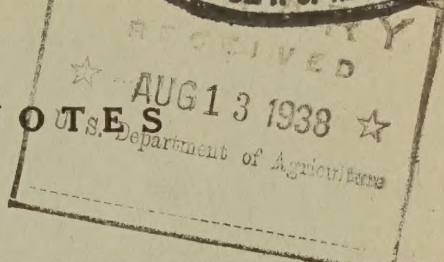
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Puerto Rico Experiment Station
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United States Department of Agriculture



AGRICULTURAL NOTES



No. 81 PAGE 1

MAYAGUEZ, P. R. SEPTEMBER 15, 1937

THE PINK BOLLWORM OF COTTON IN PUERTO RICO DURING 1936
AND RECOMMENDATIONS FOR ITS CONTROL

BY

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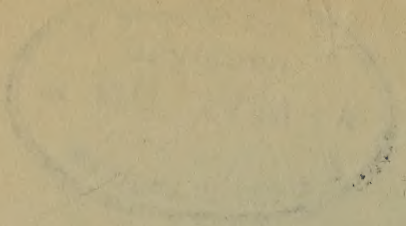
THE PURPOSE OF THESE NOTES IS TO GIVE A GENERAL ACCOUNT OF THE LIFE HISTORY AND HABITS OF THE PINK BOLLWORM, PECTINOPHORA GOSYPIELLA SAUNDERS, ITS STATUS IN PUERTO RICO IN 1936, AND TO INDICATE METHODS OF REDUCING THE DAMAGE.

THE NATURE OF THE DAMAGE CAUSED BY THE PINK BOLLWORM

PINK BOLLWORM CAUSES LOSSES IN BOTH QUALITY AND QUANTITY OF CROP.

THE DAMAGE TO SEA ISLAND COTTON BY THE PINK BOLLWORM IS CAUSED BY THE FEEDING OF THE LARVAE ON THE SQUARES AND BLOOMS, THE WALLS AND PARTITIONS OF THE BOLLS, AND THE LINT AND SEED OF THE COTTON. UPON ENTERING THE BOLL AFTER HATCHING, THE LARVAE FEED ON THE LINT AND TENDER TISSUES OF THE BOLL DURING ITS EARLIER STAGES OF GROWTH. IN THE LATER STAGES THE LARVAE FEED ALMOST EXCLUSIVELY ON THE SEED, THEREBY ARRESTING THE DEVELOPMENT OF THE LINT AND SEED AND ALSO DESTROYING THE SEED ITSELF.

IN PASSING FROM SEED TO SEED, AND FROM CARPEL TO CARPEL, THE LARVAE CUT AND DISCOLOR THE LINT. THE COTTON FROM INFESTED BOLLS IS OF AN INFERIOR GRADE, THE LINT USUALLY BEING SHORT, HARD, AND KINKY. A HEAVY EARLY INFESTATION OF THIS PEST CAUSES A SEVERE SHEDDING OF HALF-GROWN OR YOUNGER BOLLS. MORE OF THE



The page contains several lines of extremely faint, illegible text, likely bleed-through from the reverse side. The text is distributed across the middle and lower portions of the page, following a standard paragraph structure with multiple lines of writing.

INFESTED BLOOMS FAIL TO SET BOLLS THAN NORMAL BLOOMS. UNDER FAVORABLE CONDITIONS, IT IS TRUE, THE NATURAL TENDENCY OF THE PLANT WILL BE TO RESET THESE FRUITS, BUT THE BLOOMS THAT ARE REPLACED WILL MAKE BOLLS AT A MUCH LATER DATE THAN THEY NORMALLY WOULD, THEREBY SUBJECTING THEM TO A HEAVIER INFESTATION AND HENCE A GREATER AMOUNT OF DAMAGE. UNDER CERTAIN CONDITIONS, THIS PEST MAY CAUSE A TOTAL LOSS. DURING 1936 IN PUERTO RICO ABOUT 30 PERCENT OF THE CROP WAS DESTROYED.

LIFE HISTORY AND HABITS

THE ADULTS ARE SMALL MOTHS AND ACTIVE ONLY AT NIGHT.

THE ADULTS ARE SMALL DARK-BROWN MOTHS WITH A WING SPREAD OF ABOUT THREE-FIFTHS OF AN INCH FROM TIP TO TIP. THE FOREWINGS ARE BLUNTLY POINTED WITH IRREGULAR BLACKISH MARKINGS WHILE THE HIND WINGS ARE ACUTELY POINTED AND OF A SILVER GRAY COLOR WITH NO DISTINCT MARKINGS. BOTH WINGS ARE HEAVILY FRINGED POSTERIORLY.

THE ADULTS ARE ACTIVE ONLY AT NIGHT AND BY CLOSE EXAMINATION WITH A FLASHLIGHT THEY CAN BE READILY FOUND IN A RESTING POSITION ON ALMOST ANY PART OF THE PLANT. DURING THE DAY THEY CONCEAL THEMSELVES UNDER LEAVES, STONES, TRASH, CLOUDS, OR EVEN IN THE LOOSE SOIL. WHEN DISTURBED IN DAYLIGHT THEY USUALLY FLY ONLY A SHORT DISTANCE AND IMMEDIATELY HIDE UNDER THE NEAREST OBJECT. THE AVERAGE LONGEVITY IS ABOUT 14 DAYS.

THE PINK BOLLWORM MULTIPLIES RAPIDLY.

THE REPRODUCTIVE POWERS OF THE PINK BOLLWORM ARE GREAT. ONE GENERATION DEVELOPS IN ABOUT 30 DAYS. EACH FEMALE DEPOSITS FROM 100 TO 300 EGGS ON VARIOUS PARTS OF THE PLANT. THIS EXPLAINS WHY A VERY HIGH POPULATION DENSITY CAN BE BUILT UP IN FROM 3 TO 4 MONTHS FROM A VERY LOW INITIAL INFESTATION.

THE EGG STAGE LASTS ABOUT FIVE DAYS. UNDER FAVORABLE CONDITIONS, IT IS TRUE, THE NATURAL TENDENCY OF THE PLANT WILL BE TO RESET THESE FRUITS, BUT THE BLOOMS THAT ARE REPLACED WILL MAKE BOLLS AT A MUCH LATER DATE THAN THEY NORMALLY WOULD, THEREBY SUBJECTING THEM TO A HEAVIER INFESTATION AND HENCE A GREATER AMOUNT OF DAMAGE. UNDER CERTAIN CONDITIONS, THIS PEST MAY CAUSE A TOTAL LOSS. DURING 1936 IN PUERTO RICO ABOUT 30 PERCENT OF THE CROP WAS DESTROYED.

THE PINK BOLLWORM PASSES THROUGH THE FOLLOWING FOUR STAGES IN ITS DEVELOPMENT: EGG, LARVA, PUPA, AND ADULT. THE EGGS ARE ABOUT ONE-FIFTIETH OF AN INCH LONG; THEY ARE WHITE AT FIRST, BUT TURN PINKISH BEFORE HATCHING. THEY ARE LAID ON THE LEAVES, BUDS, FLOWER, BRACTS, AND BOLLS. THE MAJORITY OF THE EGGS, HOWEVER, ARE LAID ON THE BOLL, AS A RULE AT THE BASE. THE INCUBATION PERIOD IS CLOSE TO 5.5 DAYS AT 80° F.

LIFE HISTORY AND HABITS

THE LARVAL STAGE FEEDS ONLY IN FLOWERS, SQUARES, AND BOLLS.

THE ADULTS ARE SMALL MOTHS AND ACTIVE ONLY AT NIGHT.

THE LARVAE FEED ONLY IN FLOWERS, SQUARES, AND BOLLS. THE NEWLY HATCHED LARVAE ARE VERY ACTIVE AND IMMEDIATELY BEGIN TUNNELING INTO THE FRUITING FORMS AND FEEDING ON THEIR CONTENTS. DURING DEVELOPMENT, THE LARVA PASSES THROUGH FOUR INSTARS BEFORE IT REACHES MATURITY. IN THE LATER STAGE OF DEVELOPMENT THE LARVA BECOMES PINK IN COLOR, AND FROM THIS IT GETS ITS NAME. MOST OF THE LARVAE, AFTER COMPLETING THEIR FEEDING, USUALLY TUNNEL EXIT HOLES THROUGH THE BOLLS, DROP TO THE GROUND, AND SPIN SILKEN COCOONS IN THE SURFACE LITTER OR IN THE SOIL, FOR PUPATION. WHEN SQUARES ARE INFESTED, THE LARVAE MAY LEAVE THE BLOOM; OR, IF NOT FULLY DEVELOPED AT THIS TIME, MAY REMAIN IN THE OLD BLOOM, WHICH DROPS TO THE GROUND AFTER A FEW DAYS. THE PERIOD REQUIRED FOR LARVAL DEVELOPMENT IS ABOUT 14 DAYS. IN DAYLIGHT THEY USUALLY FLY ONLY A SHORT DISTANCE AND IMMEDIATELY HIDE UNDER THE NEAREST OBJECT. THE AVERAGE LONGEVITY IS ABOUT 14 DAYS.

THE PINK BOLLWORM MULTIPLIES RAPIDLY.

THE REPRODUCTIVE POWERS OF THE PINK BOLLWORM ARE GREAT. ONE GENERATION DEVELOPS IN ABOUT 30 DAYS. EACH FEMALE DEPOSITS FROM 100 TO 300 EGGS ON VARIOUS PARTS OF THE PLANT. THIS EXPLAINS WHY A VERY HIGH POPULATION DENSITY CAN BE BUILT UP IN FROM 3 TO 4 MONTHS FROM A VERY LOW INITIAL INFESTATION.

LONG-CYCLE LARVAL STAGE LASTS FOR SEVERAL MONTHS.

MANY INSECTS DEVELOP AN INACTIVE OR RESTING STAGE IN ORDER TO SURVIVE DURING UNFAVORABLE PERIODS, THAT IS, DURING PERIODS OF HIGH OR LOW TEMPERATURES, EXTREMELY DRY OR WET WEATHER, AND SUCH NATURAL PHENOMENA. THE EXISTENCE OF THIS STAGE IN THE LIFE HISTORY OF THE PINK BOLLWORM IS A PARAMOUNT FACTOR AFFECTING ITS CARRYOVER FROM ONE COTTON CROP TO THE NEXT IN PUERTO RICO, AS WELL AS IN OTHER PARTS OF THE WORLD. DURING CERTAIN PERIODS OF THE YEAR, ESPECIALLY IN DRY PERIODS, MANY WORMS INSTEAD OF TRANSFORMING DIRECTLY INTO PUPAE GO INTO A PERIOD OF REST OR INACTIVITY, IN WHICH STATE THEY REMAIN IN THE OPEN BOLLS, SEED, OR LINT FOR SEVERAL MONTHS. IN TEMPERATE CLIMATES, HOWEVER, THIS PERIOD OF INACTIVITY MAY LAST FOR 2 YEARS OR MORE. THIS INACTIVE STAGE MAKES IT POSSIBLE FOR THE PEST TO SURVIVE IN THE ABSENCE OF COTTON, BOTH WILD AND CULTIVATED, OR OTHER PLANT HOSTS. SINCE THIS LONG-CYCLE STAGE IS USUALLY PASSED IN THE SEED OF OPEN COTTON BOLLS OR IN THE SURFACE LITTER, THE NECESSITY OF DESTROYING ALL CROP REMNANTS IMMEDIATELY AFTER THE HARVEST IS OBVIOUS. MOREOVER, INASMUCH AS THIS LONG-CYCLE STAGE ALSO OCCURS IN STORED COTTONSEED, WHICH MAY BE USED FOR PLANTING OR SHIPPED TO OTHER COUNTRIES, THE STERILIZATION OF ALL STORED COTTONSEED BECOMES VERY IMPORTANT.

PUPAL STAGE IS PASSED IN THE SOIL, SURFACE LITTER, OR OPEN COTTON BOLLS.

MOST OF THE LARVAE PUPATE IN SOIL OR SURFACE LITTER WHILE OTHERS PUPATE IN THE SEED OF OPEN BOLLS OR IN THE FALLEN FLOWERS. THE DURATION OF THIS STAGE VARIES INVERSELY WITH THE TEMPERATURE, BUT LASTS ABOUT 12 DAYS AT 80° F.

HOST PLANTS OTHER THAN CULTIVATED COTTON

SEVERAL DIFFERENT PLANTS ARE HOSTS OF THE PINK BOLLWORM.

SEVERAL DIFFERENT MALVACEOUS PLANTS OTHER THAN COTTON SERVE AS HOSTS OF THE PINK BOLLWORM IN PUERTO RICO, NAMELY, MONTEZUMA SPECIOSISSIMA, KNOWN LOCALLY AS MAGA, THESPIA POPULNEA, KNOWN AS EMAJAGÜILLA, ABELMOSCHUS ESCULENTUS, KNOWN AS GUINGAMBÓ, ABELMOSCHUS ABELMOSCHUS OR ALGALIA, HIBISCUS SABDARIFFA OR VIÑA, HIBISCUS BIFURCATUS OR BUENAS TARDÉS, HIBISCUS TRILOBUS, AND ALTHAEA ROSEA, THE LAST NAMED BEING KNOWN AS VARILLA DE SAN JOSÉ. THESE PLANTS BECOME INFESTED ONLY WHEN GROWING ADJACENT TO OR NOT FAR DISTANT FROM INFESTED COTTON. HOWEVER, THE FIRST THREE SPECIES ARE FACTORS IN MAINTAINING THIS PEST FOR 3 OR 4 MONTHS DURING THE DEAD SEASON OF COTTON PRODUCTION WHILE THE OTHER SPECIES ARE NOT IMPORTANT SINCE THE NUMBER OF PLANTS FOUND IN PUERTO RICO IS VERY LIMITED. NEVERTHELESS, THE PINK BOLLWORM MAY BE INTRODUCED INTO ANY COUNTRY BY SHIPMENTS OF SEEDS OR LIVING PLANTS BEARING MATURE SEED CAPSULES OF THE ABOVE-MENTIONED SPECIES.

MAGA IS AN IMPORTANT ALTERNATE HOST PLANT OF THE PINK BOLLWORM.

MAGA, MONTEZUMA SPECIOSISSIMA, IS A TREE ENDEMIC TO PUERTO RICO. IT HAS BEEN PLANTED ALONG ROADSIDES AS AN ORNAMENTAL AND FOR SHADE BUT IS ALSO FOUND GROWING ON WASTE LAND AND ON MOUNTAIN RANGES. THIS TREE IS QUITE ABUNDANT IN THE COTTON-GROWING REGION ON THE NORTHERN COAST BETWEEN AGUADILLA AND SAN JUAN. THE WOOD IS USED IN

THE FIRST PART OF THE HISTORY OF THE
REIGN OF CHARLES THE FIRST
IN THE YEAR OF HIS AGE SIXTEEN
AND SIXTY TWO
IN THE MONTH OF APRIL
IN THE CITY OF LONDON
IN THE HOUSE OF COMMONS
IN THE PRESENCE OF THE LORDS
AND COMMONS OF GREAT BRITAIN
IN THE PARLIAMENT ASSEMBLED
IN THE YEAR OF HIS MAJESTY'S REIGN
THE FIRST OF JUNE
IN THE CITY OF LONDON
IN THE HOUSE OF COMMONS
IN THE PRESENCE OF THE LORDS
AND COMMONS OF GREAT BRITAIN
IN THE PARLIAMENT ASSEMBLED
IN THE YEAR OF HIS MAJESTY'S REIGN

THE SECOND PART OF THE HISTORY OF THE
REIGN OF CHARLES THE FIRST
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AND SIXTY TWO
IN THE MONTH OF APRIL
IN THE CITY OF LONDON
IN THE HOUSE OF COMMONS
IN THE PRESENCE OF THE LORDS
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THE FOURTH PART OF THE HISTORY OF THE
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AND COMMONS OF GREAT BRITAIN
IN THE PARLIAMENT ASSEMBLED
IN THE YEAR OF HIS MAJESTY'S REIGN

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IN THE MONTH OF APRIL
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AND COMMONS OF GREAT BRITAIN
IN THE PARLIAMENT ASSEMBLED
IN THE YEAR OF HIS MAJESTY'S REIGN

MAKING FURNITURE, INTERIOR WOODWORK, MUSICAL INSTRUMENTS, FENCE POSTS, ETC. THE LARGE SHOWY FLOWERS ARE BRIGHT RED AND REMAIN ON THE TREE SEVERAL DAYS AFTER OPENING. EVERY TREE BEARS NUMEROUS SEED CAPSULES WHICH AVERAGE ABOUT $1\frac{1}{2}$ INCHES IN LENGTH AND ABOUT $1\frac{1}{4}$ INCHES IN DIAMETER, AND EACH POD CONTAINS SEVERAL NAKED SEEDS. FRUITING FORMS ARE PRODUCED ON THIS TREE DURING THE ENTIRE YEAR ALTHOUGH BUT FEW MATURE SEED CAPSULES ARE USUALLY FOUND DURING JUNE, JULY, AUGUST, OR SEPTEMBER.

BOTH THE BUDS AND SEED CAPSULES OF MAGA BECOME RATHER HEAVILY INFESTED; AS HIGH AS 90 PERCENT OF THE MATURE GREEN SEED CAPSULES AND 35 PERCENT OF THE BUDS HAVING BEEN FOUND INFESTED WHEN GROWING ADJACENT TO HEAVILY INFESTED COTTON. AS MANY AS FOUR MATURE LARVAE HAVE BEEN FOUND IN ONE POD AND THREE IN ONE BUD. A RATHER HIGH INFESTATION IS MAINTAINED IN THE SEED CAPSULES OF THIS HOST OVER A PERIOD OF SEVERAL MONTHS IN THE ABSENCE OF CULTIVATED OR WILD COTTON. THESE FINDINGS INDICATE THAT MAGA IS AN IMPORTANT HOST IN MAINTAINING THE PINK BOLLWORM FROM ONE COTTON CROP TO THE NEXT.

THIS PLANT IS ALSO AN IMPORTANT HOST OF COTTON STAINERS, PARTICULARLY DYSDERCUS NEGLECTUS STAL. IN VIEW OF SUCH FACTS, THE DESTRUCTION OF THESE TREES IN COTTON-GROWING REGIONS TO AID IN CONTROLLING THESE TWO IMPORTANT COTTON PESTS SEEMS LOGICAL.

EMAJAGUILLA IS A HOST PLANT OF TWO IMPORTANT COTTON PESTS.

EMAJAGUILLA, THESPIA POPULNEA, IS A WILD TREE OFTEN PLANTED ALONG ROADSIDES AS AN ORNAMENTAL AND FOR SHADE. IT ALSO OCCURS IN WASTE PLACES ON THE LOWER COASTAL PLAINS, PARTICULARLY ON THE SOUTHERN COAST BETWEEN CADO ROJO AND PONCE. FRUITING FORMS IN ALL STAGES OF DEVELOPMENT MAY BE FOUND ON THIS PLANT DURING THE ENTIRE YEAR. AS HIGH AS 14 PERCENT OF THE SEED CAPSULES HAVE BEEN FOUND INFESTED WITH THE PINK BOLLWORM WHEN GROWING ADJACENT TO HEAVILY INFESTED COTTON. IT IS ALSO A VERY IMPORTANT HOST OF COTTON STAINERS, PARTICULARLY DYSDERCUS ANDREA L. IT WOULD APPEAR LOGICAL, THEREFORE, TO DESTROY ALL TREES OF THIS SPECIES FOUND GROWING ADJACENT TO CULTIVATED COTTON IN ORDER TO REDUCE THE DAMAGE FROM THESE PESTS. ON THE TREE SEVERAL DAYS AFTER OPENING, EVERY TREE BEARS NUMEROUS SEED CAPSULES WHICH AVERAGE ABOUT $1\frac{1}{2}$ INCHES IN LENGTH AND ABOUT $1\frac{1}{4}$ INCHES IN DIAMETER, AND EACH POD CONTAINS SEVERAL NAKED SEEDS. FRUITING FORMS ARE PRODUCED ON THIS TREE DURING THE ENTIRE YEAR ALTHOUGH BUT FEW MATURE SEED CAPSULES ARE FOUND DURING JUNE, JULY, AUGUST, OR SEPTEMBER. THESE FINDINGS INDICATE THAT MAGA IS AN IMPORTANT HOST IN MAINTAINING THE PINK BOLLWORM FROM ONE COTTON CROP TO THE NEXT.

OKRA AIDS IN THE CARRYOVER OF THE PINK BOLLWORM. THE OKRA, ABELMOSCHUS ESCULENTUS, COMMONLY KNOWN IN PUERTO RICO AS "GUINGAMBÓ" OR "MOLONDRON", HAS BEEN REPORTED AS A RATHER FAVORABLE HOST OF THE PINK BOLLWORM IN VARIOUS PARTS OF THE WORLD. INFESTATIONS AS HIGH AS 50 OR 90 PERCENT OF THE SEED PODS HAVE BEEN RECORDED WHEN THE PLANTS HAVE BEEN GROWING ADJACENT TO HEAVILY INFESTED COTTON. CONSEQUENTLY, IT WOULD SEEM LOGICAL TO AVOID THE GROWING OF OKRA DURING THE DEAD SEASON OF COTTON PRODUCTION. BEEN FOUND IN ONE POD AND THREE IN ONE BUD. A RATHER HIGH INFESTATION IS MAINTAINED IN THE SEED CAPSULES OF THIS HOST OVER A PERIOD OF SEVERAL MONTHS IN THE ABSENCE OF CULTIVATED OR WILD COTTON. THESE FINDINGS INDICATE THAT MAGA IS AN IMPORTANT HOST IN MAINTAINING THE PINK BOLLWORM FROM ONE COTTON CROP TO THE NEXT.

IN 1934, THE AGRICULTURAL DIVISION OF THE PUERTO RICO EMERGENCY RELIEF ADMINISTRATION STARTED A PROJECT TO ASSIST IN THE REHABILITATION OF COTTON GROWING ON THE ISLAND. IN VIEW OF THE FACT THAT THE PINK BOLLWORM WAS ONE OF THE MOST IMPORTANT FACTORS LIMITING THE PRODUCTION OF SEA ISLAND COTTON IN PUERTO RICO, THIS ORGANIZATION UNDERTOOK A PROJECT TO ERADICATE THIS PEST. WILD COTTON THAT GREW ABUNDANTLY IN WASTE PLACES AND WAS THE MOST IMPORTANT RESERVOIR FOR THE CARRYOVER OF THE PINK BOLLWORM WAS DESTROYED BY THIS ORGANIZATION FROM JUNE 1934 TO JUNE 1936.

ELMAGUILLIA, THESPIA BOULNEA, IS A WILD TREE OFTEN PLANTED ALONG ROADSIDES
IT ALSO OCCURS IN WASTE PLACES ON THE LOWER COASTAL
AND FOR SHADE.

DURING THIS PERIOD 7,896,986 WILD COTTON PLANTS WERE REPORTED AS HAVING BEEN DESTROYED.

SINCE WILD OR VOLUNTEER COTTON PLANTS ARE IMPORTANT SOURCES FOR THE CARRYOVER OF THE PINK BOLLWORM, THE ERADICATION OF THESE PLANTS FROM THE ENTIRE ISLAND OF PUERTO RICO AND ADJACENT ISLANDS IS ADVISABLE.

CULTURAL CONTROL PRACTICES

HARVEST SEASON SHOULD OCCUR DURING THE DRY PERIOD.

IN GENERAL, COTTON SHOULD BE PLANTED IF POSSIBLE SO THAT THE PLANTING SEASON COINCIDES WITH THE PERIOD OF GREATEST RAINFALL AND THE PICKING SEASON WITH THE DRIEST PERIOD. EXCESSIVE RAINFALL DURING THE HARVEST SEASON CAUSES THE COTTON TO LOSE ITS LUSTER, AND PRODUCES FAVORABLE CONDITIONS FOR THE DEVELOPMENT OF MICROORGANISMS, RESULTING IN LOSS OF TENSILE STRENGTH. IT BECOMES DIRTY AND DISCOLORED, AND THE GRADE IS MATERIALLY LOWERED. WATER-STRESSED CONDITION, CAUSED BY SHORTAGE OF WATER DURING THE PERIOD WHEN THE YOUNG BOLLS ARE ENLARGING, MIGHT RESULT IN A SHORTER STAPLE LENGTH AND MORE WASTE DURING THE MANUFACTURING PROCESSES.

SEASONS OF COTTON PRODUCTION ON THE NORTH COAST ARE NOT ADAPTED TO RAINFALL DISTRIBUTION.

A STUDY OF RAINFALL DISTRIBUTION IN THE COMMERCIAL COTTON-GROWING REGIONS ON THE NORTHERN COAST SHOWS THAT THE PICKING SEASON AT PRESENT OCCURS DURING A PERIOD OF HEAVY RAINFALL AND THE PLANTING SEASON DURING THE DRIEST PERIOD. MANY BOLLS DO NOT OPEN PROPERLY AND MANY OF THEM DECAY OWING TO EXCESSIVE RAINFALL DURING THE PICKING SEASON IN THIS AREA. THIS IS ESPECIALLY TRUE OF THOSE BOLLS THAT ARE NEAR TO OR TOUCH THE GROUND. ACCORDINGLY, A REVERSAL OF THE SEASONS OF COTTON PRODUCTION IN THIS AREA WOULD GREATLY BENEFIT THE GROWERS SINCE MORE COTTON OF SUPERIOR QUALITY WOULD BE PRODUCED BY SUCH A PRACTICE. PLANTING IN AUGUST AND HARVESTING AND DESTROYING THE DYING PLANTS BY MAY 1 IS, THEREFORE, ADVISED. IT HAS BEEN SAID THAT THE PLANTING SEASON IN THE PAST WAS ADJUSTED SO THAT THE HARVEST SEASON OCCURRED DURING THE SCHOOL VACATION SO THAT PLANTERS' CHILDREN WERE ABLE TO PICK THE COTTON. ALSO, IF THE HARVEST SEASON OF COTTON PRODUCTION OCCURRED IN DECEMBER, JANUARY, AND FEBRUARY, AS ON THE SOUTH COAST, IT WOULD INTERFERE WITH THE HARVEST OF SUGARCANE.

THE AVERAGE YEARLY RAINFALL DISTRIBUTION IN THE COTTON REGIONS OF THE SOUTHERN COAST OF THE ISLAND IS ESSENTIALLY THE SAME AS ON THE NORTHERN COAST. THE PRESENT PRACTICE OF COTTON PRODUCTION IN THIS AREA IS WELL ADAPTED TO THE RAINFALL DISTRIBUTION. ON THE SOUTH COAST, THE PLANTING SEASON OCCURS DURING THE PERIOD OF GREATEST RAINFALL AND THE HARVEST SEASON DURING THE DRIEST PERIOD.

A REVERSAL OF THE SEASONS OF COTTON PRODUCTION ON THE NORTH COAST WOULD AID PINK BOLLWORM CONTROL.

IT WOULD SEEM LOGICAL TO BELIEVE THAT MORE COTTON OF A SUPERIOR QUALITY WOULD BE PRODUCED FROM A GIVEN ACREAGE IF THE PLANTING AND HARVEST SEASONS OF

COTTON PRODUCTION WERE REVERSED ON THE NORTH COAST; MOREOVER, SUCH A CHANGE WOULD BE EXPECTED TO AID MATERIALLY IN THE CONTROL OF THE PINK BOLLWORM, BECAUSE (1) UNIFORM PLANTING, GROWING, HARVESTING, AND DEAD SEASONS OF COTTON PRODUCTION WOULD BE ESTABLISHED FOR THE ENTIRE ISLAND, THUS PREVENTING INFESTATION BY THE FLIGHT OR WIND CARRIAGE OF MOTHS FROM ONE COAST TO THE OTHER; (2) THE DEAD SEASON WOULD COINCIDE WITH THE PERIOD WHEN VERY FEW MATURE SEED CAPSULES OCCUR ON MAGA, MONTEZUMA SPECIOSISSIMA, AND AS A RESULT THIS PEST WOULD BE MORE LIMITED IN FINDING SUITABLE FRUITING FORMS IN WHICH TO BREED UP IN LARGE NUMBERS DURING THE DEAD SEASON TO CARRY OVER FROM ONE COTTON CROP TO THE NEXT.

LONG GROWING PERIODS OF COTTON PRODUCTION FAVOR THE PINK BOLLWORM.

THE GEOGRAPHIC POSITION OF PUERTO RICO IS SUCH THAT CLIMATIC CONDITIONS FAVOR THE DEVELOPMENT OF THE PINK BOLLWORM THROUGHOUT THE YEAR. LONG GROWING PERIODS, THEREFORE, ARE FAVORABLE TO THE INCREASE OF THIS SPECIES AND ARE THE MOST IMPORTANT FACTOR LIMITING THE ABUNDANCE OF THIS PEST ON CULTIVATED COTTON FROM YEAR TO YEAR. IN ORDER TO MINIMIZE THE DESTRUCTIVENESS OF THIS PEST IT SEEMS ADVISABLE TO HAVE A DEAD SEASON OF THREE TO FOUR MONTHS BETWEEN ONE COTTON CROP AND THE NEXT; SUCH A PERIOD OF NON-CROPPING SHOULD BE STRICTLY ENFORCED BY SOME RESPONSIBLE ORGANIZATION. THE DEAD SEASON SHOULD BE AT THE SAME PERIOD OF THE YEAR FOR THE ENTIRE ISLAND.

DOMESTIC QUARANTINE LAW PROVIDES PLANTING REGULATIONS TO MINIMIZE PINK BOLLWORM.

ACCORDING TO DOMESTIC QUARANTINE LAW NO. 4, AS APPROVED BY THE INSULAR PLANT QUARANTINE BOARD JULY 1, 1934, THE GROWING OF COTTON AND OKRA HAS BEEN LIMITED TO CERTAIN PERIODS OF THE YEAR FOR THE PURPOSE OF CONTROLLING THE PINK BOLLWORM. THE PRESENT LAW PROVIDES THAT COTTON OR OKRA CANNOT BE GROWN ON THE NORTHERN COAST FROM SEPTEMBER 30 TO JANUARY 1, AND ON THE SOUTHERN COAST FROM MAY 15 TO JULY 30 OF EACH YEAR. HOWEVER, MOST FARMERS DO NOT COMPLY WITH THIS QUARANTINE REGULATION AND AS A RESULT, A VERY SHORT, IF ANY, CLOSED SEASON OF COTTON PRODUCTION IS PROVIDED FOR ON EITHER COAST.

COMPANION CROPPING INDIRECTLY FAVORS THE PINK BOLLWORM.

COMPANION CROPPING BETWEEN COTTON AND CORN IS A RATHER COMMON AGRICULTURAL PRACTICE ON THE SOUTHERN COAST OF PUERTO RICO. THE COTTON ROWS ARE PLANTED $3\frac{1}{2}$ TO 4 FEET APART, WITH ONE OR MORE PLANTS IN HILLS SPACED $2\frac{1}{2}$ TO 4 FEET APART; CORN IS THEN PLANTED BETWEEN EACH ROW OF COTTON OR EVERY SECOND ROW. IN SUCH CASES, THE COTTON IS FREQUENTLY CROWDED OUT OR ITS GROWTH MATERIALLY RETARDED. COMPANION CROPPING WITH BEANS AND TOBACCO IS ALSO PRACTICED TO A LIMITED EXTENT.

UNDER PINK BOLLWORM CONDITIONS, COMPANION CROPPING BETWEEN COTTON AND ANY OTHER CROP IS USUALLY REGARDED AS A POOR AGRICULTURAL PRACTICE WHICH RETARDS PRODUCTION, WHEREAS EVERY MEANS SHOULD BE TAKEN TO PRODUCE A QUICK CROP BEFORE THE INITIAL PINK BOLLWORM INFESTATION BUILDS UP. IT IS VERY IMPORTANT TO PRODUCE THE CROP QUICKLY SO THAT THE STALKS AFTER HARVEST MAY BE DESTROYED AS SOON AS POSSIBLE TO PREVENT THE PINK BOLLWORM FROM BREEDING AND IN ORDER TO HAVE AS LONG A DEAD SEASON AS POSSIBLE BETWEEN HARVESTING AND THE NEXT CROP. COMPANION CROPPING OF ANY KIND WITH COTTON, THEREFORE, IS TO BE AVOIDED.

SEED TREATMENT

SEED STERILIZATION BY HEAT AS A CONTINUOUS PROCESS OF GINNING IS DESIRABLE.

THE SOURCE OF PINK BOLLWORM INFESTATIONS IN MANY COTTON FIELDS ORIGINATES FROM LONG-CYCLE LARVAE IN SEED GIVEN TO THE GROWERS FOR PLANTING. THEREFORE, STERILIZATION OF COTTON SEED BECOMES A VERY IMPORTANT MEASURE IN CONTROLLING AND PREVENTING THE SPREAD OF THIS PEST.

THE PRESENT METHOD OF STERILIZING COTTONSEED AGAINST THE PINK BOLLWORM BY THE USE OF CARBON DISULPHIDE IS EXPENSIVE AND NOT ENTIRELY EFFECTIVE. EQUIPMENT TO HEAT SEED TO A TEMPERATURE OF 145° F. AS A CONTINUOUS PROCESS OF GINNING HAS PROVED TO BE AN EFFECTIVE AND CHEAP METHOD OF STERILIZING COTTONSEED. IT WOULD BE DESIRABLE, THEREFORE, TO EQUIP THE GIN IN PUERTO RICO WITH A COTTONSEED STERILIZER WITH A THERMOGRAPH ATTACHMENT SO THAT THE TEMPERATURE OF THE SEED CAN BE RECORDED DURING STERILIZATION.

FIELD SANITATION AROUND THE HOME IS AN IMPORTANT FACTOR IN CONTROL.

IN PUERTO RICO THE COTTON GROWERS USUALLY CLEAN THEIR COTTON AT HOME BEFORE IT IS DELIVERED TO THE MARKETING ASSOCIATION FOR GINNING. THE CLEANING PROCESS CONSISTS IN PICKING OUT BY HAND THE STAINED, SHRIVELED, OR DIRTY LOCKS. THESE DAMAGED COTTON LOCKS ARE GENERALLY THROWN OUT IN THE YARD OR LEFT UNDER THE HOUSE WITHOUT BEING DESTROYED, AND USUALLY THIS COTTON IS HEAVILY INFESTED WITH THE PINK BOLLWORM. ALSO, THE STORED SEED COTTON IS OFTEN KEPT AT HOME FROM ONE TO SEVERAL MONTHS BEFORE IT IS DELIVERED TO THE GIN. MUCH DAMAGE TO COTTON IS CAUSED BY INFESTATIONS THAT ORIGINATE FROM UNSANITARY CONDITIONS AROUND THE HOME. ALL THE WORTHLESS, DAMAGED COTTON SHOULD BE IMMEDIATELY BURNED AND ALL SEED COTTON DELIVERED TO THE GIN AS SOON AS POSSIBLE AFTER IT IS CLEANED.

INTRODUCTION OF FOREIGN PARASITES MAY AID IN CONTROL.

SINCE PUERTO RICO IS CLIMATICALLY SUITED FOR INSECT PROPAGATION DURING THE ENTIRE YEAR, IT WOULD SEEM TO BE AN IDEAL PLACE FOR THE INTRODUCTION AND COLONIZATION OF BENEFICIAL INSECTS. THE PINK BOLLWORM IS A COMPARATIVELY RECENT INTRODUCTION, AND NONE OF THE NATIVE PARASITES ARE EFFECTIVE IN HOLDING IT IN CHECK. THREE SPECIES OF FOREIGN PARASITES WERE INTRODUCED DURING 1935-36. ALTHOUGH ALL THREE SPECIES HAVE BEEN RECOVERED, IT IS UNCERTAIN WHETHER THEY HAVE BECOME ESTABLISHED. THE COLONIZATION OF THESE PARASITES AND THE INTRODUCTION OF OTHER SPECIES SHOULD BE CONTINUED.

PUERTO RICO MARKETING ASSOCIATION FOR MINOR CROPS

MARKETING ASSOCIATION CONTROLS COTTON INDUSTRY IN PUERTO RICO.

IN JANUARY 1935 THE PUERTO RICO MARKETING ASSOCIATION FOR MINOR CROPS, A COOPERATIVE ASSOCIATION OF COTTON GROWERS, WAS ORGANIZED; THE PRODUCTION OF SEA ISLAND COTTON IS NOW UNDER THE CONTROL OF THIS ORGANIZATION. THIS ASSOCIATION PURCHASED

THE ONLY GIN ON THE ISLAND FROM THE SPOOL COTTON COMPANY OF NEW YORK.

MOST OF THE COTTON GROWERS ON THE ISLAND DURING THE PAST YEAR SIGNED CONTRACTS WITH THIS ASSOCIATION AGREEING TO SELL THEIR ENTIRE CROP TO THE ASSOCIATION AS SOON AS IT IS PICKED AND CLEANED OR AT THE EARLIEST POSSIBLE DATE. IN THIS CONTRACT THE GROWER ALSO AGREES TO ACCEPT THE CLASSIFICATION OF HIS COTTON BY THE ASSOCIATION. THE ASSOCIATION AGREES TO SELL THE ENTIRE CROP FOR THE GROWERS AND AFTER DEDUCTING THE NECESSARY EXPENSES SUCH AS FREIGHT, INSURANCE, AND GINNING AND ADMINISTRATION COSTS, THE REMAINDER IS RETURNED TO THE GROWER. THE ASSOCIATION SUPPLIES THE PLANTING SEED AND MAY ADVANCE MONEY ON THE COTTON FOR FERTILIZER, INSECTICIDES, AND LABOR.

MARKETING ASSOCIATION COULD AID IN PINK BOLLWORM CONTROL.

SINCE UNIFORM PERIODS OF PLANTING, GROWING, AND DEAD SEASONS OF COTTON PRODUCTION ARE ESSENTIAL TO COMBAT THE PINK BOLLWORM, PRODUCTION CONTROLLED BY A RESPONSIBLE ORGANIZATION SEEMS IMPORTANT. THIS ASSOCIATION COULD MATERIALLY AID IN CONTROLLING THIS PEST BY (1) REGULATING THE PLANTING DATE BY REFUSING TO DISTRIBUTE SEED STOCK UNTIL THE PROPER TIME, (2) REGULATING THE GROWING AND HARVEST PERIODS BY REFUSING TO ACCEPT SEED COTTON AFTER A CERTAIN PREDESIGNATED DATE, AND (3) ENCOURAGING THE FARMERS TO CLEAN UP THE CROP REMNANTS IMMEDIATELY AFTER THE COTTON IS HARVESTED. THE ASSOCIATION COULD ALSO REGULATE THE QUALITY OF THE LINT BY REGULATING THE CHARACTER OF THE SEED STOCK.

SUMMARY OF CONTROL RECOMMENDATIONS

UNIFORM PLANTING, GROWING, HARVESTING, AND DEAD SEASONS OF COTTON PRODUCTION FOR THE ENTIRE ISLAND WOULD SEEM LOGICAL.

COTTON GROWN IN ANY PART OF THE ISLAND DURING THE DEAD SEASON, THAT IS, BETWEEN MAY 1 AND JULY 30 OF EACH YEAR, MAINTAINS SOURCES OF PINK BOLLWORM INFESTATION FOR THE SUBSEQUENT NEW CROP AND IS TO BE AVOIDED.

SINCE OKRA, ABELMOSCHUS ESCULENTUS, IS A FAVORABLE ALTERNATE HOST PLANT OF THE PINK BOLLWORM, THE GROWING OF THIS VEGETABLE DURING THE DEAD SEASON OF COTTON PRODUCTION IS NOT DESIRABLE.

LONG-CYCLE LARVAE IN THE SEED OF OPEN COTTON BOLLS AND IN THE SURFACE LITTER ARE IMPORTANT SOURCES OF CARRYOVER OF THIS PEST FROM ONE CROP TO THE NEXT. THEREFORE, THE DESTRUCTION OF ALL CROP REMNANTS IMMEDIATELY AFTER THE HARVEST IS A GOOD AGRICULTURAL PRACTICE.

SINCE WILD OR VOLUNTEER COTTON PLANTS ARE ALSO IMPORTANT SOURCES OF CARRYOVER OF THIS PEST, THE ERADICATION OF THESE PLANTS FROM THE ENTIRE ISLAND OF PUERTO RICO AND ADJACENT ISLANDS IS DESIRABLE.

MAGA, MONTEZUMA SPECIOSISSIMA, AND EMAJAGUILLA, THESPIA POPULNEA, ARE IMPORTANT HOST PLANTS OF THE PINK BOLLWORM AND COTTON STAINERS. THE DESTRUCTION OF THESE TREES IN COTTON-GROWING AREAS IS, THEREFORE, ADVISABLE.

COMPANION CROPPING BETWEEN COTTON AND ANY OTHER CROP IS A POOR AGRICULTURAL PRACTICE AND IS TO BE AVOIDED.

THE HEATING OF COTTONSEED TO A TEMPERATURE OF 145° F. AS A CONTINUOUS PROCESS OF GINNING IS A CHEAPER AND MORE SATISFACTORY METHOD OF STERILIZING THE SEED AGAINST THE PINK BOLLWORM THAN BY THE PRESENT METHOD OF USING CARBON DISULPHIDE.

MUCH DAMAGE TO COTTON IS CAUSED BY INFESTATIONS THAT ORIGINATE FROM UNSANITARY CONDITIONS AROUND THE HOME. IT IS LOGICAL, THEREFORE, TO BURN ALL DAMAGED COTTON FOUND AROUND THE HOME AND TO DELIVER ALL STORED SEED COTTON TO THE GIN AS SOON AS POSSIBLE AFTER IT IS CLEANED.

THREE SPECIES OF PINK BOLLWORM PARASITES HAVE BEEN INTRODUCED, AND THIS WORK WITH OTHER SPECIES SHOULD BE CONTINUED.

